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HASTY NOTES

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MADE IN THE

AUTUMN OF 1883.

SUBMITTED TO THE CHIEF OF ENGINEERS

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WILLETS POINT, N. Y. H.,
November 1, 1883.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.,
Washington, D. C.

GENERAL:

So far as my duties as a member of the Gun Foundry Board would allow, I took advantage of my recent visit to Europe to obtain all possible information respecting matters of professional interest to the Corps of Engineers.

Some matters were communicated confidentially—thus I was permitted to inspect the new iron defenses at Cronstadt, but with the request that nothing should be made public; and I was shown some recent improvements in the English submarine mining service, which, although no conditions were imposed, I judge more fitting for a confidential paper to be printed here for our own use.

Other matters were of a general character with no such restrictions as to publicity, and during the return voyage I have hastily thrown my notes into the form in which I now transmit them. Of course matters pertaining to the special duties of our Board are not included.

The Board was everywhere received with great courtesy; but I feel under obligations personally to Major General Sir A. Clarke, Inspector General of Fortifications; Colonel E. D. Malcolm; Lieutenant Colonel W. Crossman; Major R. H. Vetch; Major R. G. Armstrong; Major M. T. Sale; Captain F. R. de Wolski; and Lieutenant G. A. Carr, all of the Royal Engineers, and to Captain A. Van der Howen of the Russian Artillery Guard.

Very respectfully, your obedient servant,

HENRY L. ABBOT,
Lieut. Col. of Engineers, Bvt. Brig. Gen., U. S. A.

FABRICATION OF MODERN ARMOR.

The Gun Foundry Board, of which I am a member, witnessed the fabrication of compound armor both by the Wilson and by the Ellis patents; also the forging and tempering of steel armor at Le Creusot. As these matters hardly come within the scope of our official report, the following brief account may be of interest:

CAMMELL & CO., SHEFFIELD.

This establishment manufactures compound plates under the Wilson patent, as is also done at St. Chamond, and by Marrel Frères in France. We saw at Sheffield a plate ordered for the Italia and made by this process, which was 19¼ inches thick and weighed 50 tons. The one we saw manufactured was not quite so large, being only 18 inches in final thickness.

The wrought iron backing was intensely heated in the furnace when first seen. It had been previously formed by the usual process of rolling. Six plates, each 4 inches thick, had been thus prepared, and they were now to be rolled into a single one 18 inches thick.

An iron box mould was ready, lined with a fire-proof coating. In length and width it slightly exceeded the dimensions of the proposed compound plate, but in thickness it was exactly the same. This mould, open on one side, was provided with trunnions, so that it could easily be revolved from a horizontal to a vertical position.

The furnace doors were thrown open, and the white hot mass was drawn down and quickly entered between the rolls, which were of the most massive character. During its reduction from 24 to 18 inches in thickness, care was taken to remove all oxide scales by scrapers and by jets of water.

After the completion of the rolling, the plate still intensely heated, was run on its truck carriage to the mould, slid in horizontally, and wedged in position by iron strips and moulding sand at the ends. The mould was then revolved to a vertical position, leaving an open space of 10 inches on one side of the plate for the reception of the steel. Over the top of this space was placed a long receiver, pierced with ten holes. Two ordinary ladles filled with fluid steel, prepared by the Bessamer process, were moved up and so tapped as to discharge rapidly into the cavity, soon filling it with the white hot metal.

We were informed that after cooling for two hours in the mould the compound plate would be reheated in the furnace, and again rolled down to a thickness of 18 inches. After cooling the edges would be planed straight; the bolt holes would be tapped and the plate would be ready for delivery. We saw samples at various stages of these operations, and in all the union between the steel and iron appeared excellent.

JOHN BROWN & CO., SHEFFIELD.

At this establishment the armor plates are manufactured under the Ellis patent, the essential difference being that the face is formed of a hard rolled steel plate cemented to the wrought-iron backing by a fluid layer introduced between them.

The largest plates weigh 50 tons, being 20′×10′×10″, or other equivalent dimensions. The weight fixes the limits as to size. We saw one 22′×9½′×10″ actually manufactured. This plate consisted of a 12-inch wrought-iron plate and a 4-inch steel-plate, separated by a space of 4 inches. This space was preserved by five rows, each of 8 steel pins, and by flanged side and bottom strips (mostly to be subsequently cut off). A clutch hold was prepared by a mid-top strip of like nature.

After carefully covering all exposed steel surfaces with gannister brick to prevent melting or oxidation, the mass was placed in a reverberatory furnace, and brought to a white heat. It was then drawn out, the bricks were removed, and an ingenious clamping clutch was adjusted to the top, so that the mass could be raised vertically and lowered into a sunken iron moulding pit, one side of which was movable by hydraulic power. This side was forced up against the steel plate, holding the whole firmly in place.

The space between the iron and steel was then filled with fluid Bessamer steel poured from a ladle into a top receiver pierced with several holes. When full the whole was covered with moulding sand and weighted with a heavy mass of iron.

After cooling about two hours the mass would be reheated and rolled down to a thickness of 10 inches, the ends and sides would be sawed off hot or planed off cold, and the bolt holes would be tapped into the wrought-iron backing.

Several plates completed and in progress were examined. They showed dis-

tinctly the three kinds of metal composing them. Indications of bad union were very few and small in extent. Where small plates are ordered, for economic reasons they are made by cutting large ones.

The largest plates cost from £85 to £90 per ton, there being no difference in this respect between the two processes of manufacture, nor does there seem to be any marked difference in the quality of the work done under the two patents.

LE CREUSOT, FRANCE.

The armor-plates manufactured at this establishment are of cast steel made by the open hearth process, forged under the 100-ton hammer, and tempered in oil.

The largest size is 60 centimetres thick, 3 metres wide, and of sufficient length to weigh 40,000 kilos. Such a plate would require a 75-ton ingot, the loss being chiefly in the sinking head. We saw many 40 centimetre plates now making for the French navy. The price delivered at Havre, if the plates were ordered of complex forms (as for ships) would be $1\frac{9}{10}$ francs per kilogram—if flat it would be less. They are, therefore, cheaper than compound plates at present.

We witnessed the process of casting an ingot, forging a plate, and tempering one in oil.

Seven Siemens furnaces are arranged, three on one side and four on the other, of a double railway track leading to a deep pit containing the flask. The capacity of each furnace is 15 tons, giving the power of casting an ingot exceeding 100 tons in weight. In front of each is an hydraulic turn table, which can be lowered below the floor a dozen feet or more, and revolved at pleasure. Railway cars carrying ladles are placed in front of each furnace on these tables, and are filled and then run over the flask in succession by a locomotive. Here they are tapped from the bottom, the flow being led into the bottom of the flask. Three ladles were used in casting the ingot (45 tons) witnessed by us, and the total time was thirty-three minutes. Care was taken to keep the flow uniform throughout.

All these armor-plates are forged by the 100-ton hammer, the largest in the world. The ingot we saw treated (75 tons) had been heating about forty hours. We were informed that it would be reduced in thickness from 1.4 metres to 0.55 metres by about a dozen successive hammerings, requiring ten days in all. The area of the face of the tup was about $6' \times 1'.5 = 9$ square feet; its weight was 100 tons; and its fall was 5 metres, or less as desired. The porter bar for moving the ingot was a massive iron beam about a square foot in cross section. It served both to direct and to counterpoise the ingot, the hold of the crane being adjusted to effect the latter object. To prevent the vibration from breaking this huge porter bar, it had been warmed by suspending fires under it.

When the crane took the weight, a crowd of men with bars engaged in square nuts slipping on the beam, directed the white hot ingot under the hammer so that the blow would fall on one side, and near the sinking head end. After a few preliminary aims the blow fell, then another harder, and then a couple from the full height. The concussions were tremendous, and an indentation about 6 inches deep and the full size of the head was made about two-thirds across the plate. The latter was then drawn back, and a similar dent was made by the side of the first. This operation was repeated until the forging extended to the end of the ingot. The remaining third was next treated in the same manner, reducing the whole to a uniform thickness of about 4 feet. The end showed two slight bulges, the lines of greatest extension being about a foot above the bottom, and a foot below the top. The action of the hammer evidently extended to the middle of the mass, but

not quite so effectually as at points nearer the seat of the blow. The spectacle of this forging was grand beyond words, especially as seen at night by its own light.

The tempering was done in an immense iron tank half raised above the bottom of a pit 15 metres deep. It contained 180 tons of colza oil. The plate was brought to a dark red heat in a special furnace, also in the pit. The plate stood vertically on one edge, and the side walls of the furnace formed wide flues on each side for the passage of the gases and flame from six grates near the bottom (three on each side). The draught was through the top cover.

When the requisite temperature was reached the top was removed, and the ends were thrown open. A traveling crane was run over the plate and hooks were engaged under the ends. The whole was moved over the tank and the plate was lowered quickly into the oil, which at first boiled furiously. We were informed that it would remain submerged about four hours. Mention was made of subsequent annealing, but no definite information was given.

It is impossible to witness the manufacture of one of these immense plates without being impressed with the thorough manner in which all the processes are carried out at Le Creusot.

MASONRY TARGETS AT SHOEBURYNESS.

The most important object of my vist here was to examine the targets, still in position, designed to determine the best method of strengthening masonry against modern ordnance. The following statement is chiefly based on what I saw and was told on the spot.

The end proposed in the firing was to learn the power of the 80-ton gun, loaded with 450 pounds of powder and a chilled projectile of 1,700 pounds weight, and fired at a range of 200 yards, giving a striking velocity of about 1,580 feet per second, and an energy roughly of 30,000 foot-tons, upon masonry resembling that existing in many British reinforced sea-coast defenses. The target was a solid granite wall 14 feet high and 9 feet thick, backed with 6 feet of good Portland cement concrete, and faced in rear by a wall of brick 5 feet thick, the whole forming a substantial mass 20 feet thick and about 80 feet long. Against its left, and upon the same line, was placed a mass of Portland cement concrete to serve as an end buttress, and also to receive one shot. Its height was the same as the rest of the target; its length was 30 feet; its thickness about 40 feet. About 25 running feet of the right of the target was reïnforced at the back by a mass of concrete to the same depth, and the middle was supported by an earth embankment similar in mass. This target was constructed between October, 1882, and March 31, 1883, and the firing was done during the past summer and autumn, *i. e.*, before the concrete could have fully hardened. Immediately over the plates to be tested, an attempt was made to increase the stability by weighting the top with old armor-plates, but this was not done elsewhere.

The first shot (August 21) struck the masonry on the right where it was without any protection. It penetrated the granite and concrete to the brick wall, which deflected it to the right, and finally to the front, so that the projectile came to rest in a reversed position after traversing about 25 feet. The hole as seen by me was large enough for a boy to enter, and the masonry around it was somewhat cracked, but not very seriously. The shot broke up.

The second shot (September 11) was fired at a 12-inch compound plate, 7 feet by 7 feet, made by Cammell & Co. (Wilson's patent), and secured directly to the masonry without any elastic backing. It was bordered by an iron frame. The

shot penetrated the plate, bulging the back into the granite, and showing its point entirely through the iron, although fast in position. The rear of the shot broke up. The blow upon the granite fell on a vertical joint between two blocks, both of which were badly shattered throughout their whole extent. The indent was about 6 inches. The lower edge of the next course above resisted the shock so well that the wrought iron projection was pressed into a flat shelf at right angles to the plane of the plate, and about 3 or 4 inches wide. In fine, the injury to the masonry in this case was insignificant.

The third shot (September 11) was fired at a wrought iron shield, 12 feet by 7 feet, composed of two 8-inch plates separated by 5 inches of wood and backed by same, *i. e.*, of 16 inches of iron and 10 inches of wood. Six Palliser bolts held the plate to the granite. The shot penetrated the shield and granite, and rested at the concrete just behind it—going, say 10 feet in all. The hole through the shield was sheathed by the iron forced back, and that in the granite was larger than the shot.

The plate covered so much of the face of the granite that the local extent of the cracks was hidden; but a few appeared beyond its border, chiefly radial. The shot broke up.

The fourth shot (September 20) made a hole 32 feet deep straight into the concrete, which nearly closed the opening. The mass was badly cracked, and quite a large surface had fallen down around the point of entrance. Considerable firing was witnessed by me at Shoeburyness, but it had no special interest with one exception. This was the practice of an 8-inch rifled howitzer of 70 hundred weight firing shells weighing 180 pounds at a siege battery constructed in the marsh at a distance of 500 yards. The howitzer was fired over the parapet which completely covered it, being pointed by sighting back at a target placed in rear. The gunner placed his eye in front of a rimbase sight, and brought the rear sight into line. Five shots were made, and they all fell with great precision into the battery serving as a target—passing over and dropping quite near the crest.

THE DOVER TURRET.

I was permitted to examine this work in detail. The following points were of interest, in addition to what I already knew from the writings of Colonel Inglis, Royal Engineers.

The turret forms at present the end of the breakwater; but it is proposed to extend the latter with a view to enlarge the harbor. If this be done the turret will be left inside the line of the work, which its position on a sort of return will facilitate. The sea side of the breakwater is raised into a parapet against the waves, serving to protect a passage-way on the harbor side; and this passage-way extended under the return at the end forms the entrance to the work.

Ordinary high-water at Dover is 19 feet above ordinary low-water; the extreme range being about 23 feet. In great storms the waves break over the entire structure of the breakwater, and difficulty is experienced in keeping things dry inside the turret. Once, before it was quite completed, the engines were flooded and it was needful to send divers down into the room. This liability has caused some of the peculiarities of the construction.

Advantage is taken of the horizontal space afforded by the breakwater. Thus the magazines are not crowded under the turret, but are at some distance laterally, and the engine-room is placed so near the harbor side as to permit high windows for light. The reference of the magazine floor is that of ordinary high-water, and the engine-room floor is 4 feet lower. The engines are placed in a

water-tight iron caisson, forming the floor and sides of the room. The magazines are lined with asphalt throughout, but I noticed marks of leakage on the walls and dampness everywhere. There are two magazines for powder, designed together to hold about 70 rounds. The explosive is stored in boxes holding 112 pounds each, four of them constituting one charge. The projectiles are kept in other rooms. A passage-way with a railway track leads from the magazine to the lifts, so there is no carrying by hand. The cars are small enough to just hold their load; and their bodies form the semi-cylinder, which, when raised to the proper height, bridges the interval between the depressed muzzle of the gun and the head of the chain-rammer. This arrangement renders the loading by steam-power rapid and comparatively simple. It involves the revolving of the turret always to a fixed position, and the depressing of the gun to about 16° below the horizontal.

The engine, which revolves the turret works the lifts and chain-rammers and in fact does all the hard work required for operating the two 80-ton guns, is of 200 horse power.

The magazines and engines are separated completely by masonry. This involves narrow and winding passages with occasional ladders, but probably habit would accustom the gunners to use them. Indeed one is impressed with the care which has been observed to reduce all dimensions to the minimum possible. The guns fill the turret so completely that no space is lost, and yet they are of the old short muzzle-loading pattern. Perhaps the explanation of what appears to be rather unnecessary crowding, may be found in the fact that the turret was begun with the intention of arming it with 38-ton guns. This reason was assigned for the peculiar base-revolving arrangement (withdrawn inward from under the armor-plating) which has been a standing cause for speculation to our officers. Certainly in planning turrets for ourselves this one may be accepted as too small in every respect for the most recent patterns of this calibre of ordnance.

The actual weight of the turret and guns slightly exceeds 1,000 tons—the estimate was 800 tons, but it has been increased. The weight rests on 32 steel cones 16 inches in diameter and 16 inches long, revolving on rails. The centre pintle bears no weight. The mass of armor constituting the turret proper is held by friction alone upon a sort of independent carriage supported by these cones, the object being to save the gearing from part of the shock caused by the impact of a projectile.

The armor consists of three 7-inch plates, two 2-inch plates, and 6 inches of wood—total 25 inches of iron and 6 inches of wood. The embrasures show the cross-section, there being no inner rings. The top is covered by about 2 inches of iron, which is arched over each gun a little to give more space; and over the breech is a lattice work. To point the guns the officer looks through a simple hole in the top, through which he thrusts his head; but this will be modified by a plated protection.

The glacis is of stone masonry covered with 2 feet of concrete on top. It varies in thickness from 9 feet on the harbor side to a minimum of 23 feet on the front. The plan of the turret being circular and of the masonry an irregular polygon, the latter thickness is exceeded at most points. The magazines are covered only by 23 feet of masonry—granite faced, concrete filled, and brick backed, probably in about the proportion of the recent Shoeburyness targets. At no place is there any surface armor over the masonry, and no projects have yet been suggested for applying any. A provision, however, has been made to reinforce the

base of the turret against projectiles striking the top of the concrete near it. The heavy armor extends only 2 feet below the glacis crest, leaving a free space of 7 inches (which is closed against water by a cover secured to the turret). One 8-inch plate is bedded vertically in the masonry, a few inches in front of the interior slope on the exposed sides of the work. Its top appears at the surface of the concrete, and it extends only a short distance down. About 2 feet outside and parallel to this is a 10-inch plate, also vertical. Its top is at the reference of the bottom of the other, and its bottom reaches the plane of the traverse plates on which the cones revolve. In my judgment some radical changes will be necessary in this mosonry glacis when the results of the recent Shoeburyness trials have been fully considered. Indeed they were made for solving such problems.

It only remains to consider the mode of operating the turret. This is controlled by an ingenious system of signals from the officer above to the engine-room. At the latter place is a dial-plate like the face of a clock, showing azimuths. Two indices revolve on it. One is moved by the revolution of the turret, the other by gearing under control of the officer above. The officer adjusts his sights on the object and keeps them there, while the person in charge of the engine works the gearing until his index comes under that of the officer. An electrical bell continues to ring until all is right, being started by the officer when he is ready to begin pointing. A speaking-tube is also available for his use.

This system was tested practically for the first time a few weeks before my visit. Each gun was fired five times, some with half and some with full charges. Everything worked satisfactorily except in one respect. The recoil of the first gun caused the turret to revolve about 10 inches, so that repointing was needful for the other. This difficulty it is proposed to meet by a brake.

Dover is strongly fortified against a land attack, as well as on the sea side. Beside the turret about thirty 9-inch and 10-inch guns, in cliff batteries, defend the harbor. I noticed one 7-inch gun mounted on a Moncrieff carriage, but the others seen by me were behind earthern parapets very much after our own system.

ENGINEER ESTABLISHMENT AT CHATHAM.

There were at my visit only about 85 Royal Engineers and 40 officers of other branches of the service under instruction, rather less than usual. The course is for two years, and includes theoretical as well as practical work.

The companies of enlisted men are largely instructed by non-commissioned and warrant officers acting under direction of the company officers. The young officers are not allowed to have anything to do with their drill and exercises except to witness them.

The soldiers are drilled as infantry and trained in shop-work, such as carpentry, lathe work, carriage and wheelwright work, iron casting, iron turning, &c. I saw one squad engaged in welding a wagon axle. Beside this they have the usual exercises in sapping and mining, field fortification, tube well-boring, pontoniering, military telegraphy, &c. My chief attention was given to the torpedo department, described elsewhere, but the following points are worthy of mention here.

MODELING IN SAND.

In addition to what was exhibited in 1873, and which we have followed with so much advantage at Willets Point, I saw a correct model of a neighboring village which had been constructed from a contoured survey. The problem proposed

had been to devise suitable works to put it rapidly in a defensive state; and everything was constructed in detail and on the proper scale. It seemed to be an excellent study.

This modeling is combined with the construction of field works on the natural scale. Wire entanglement forms an interesting feature. The German practice, as here shown, favors stakes about 4 feet high, so crossed and interlaced with wire as to be absolutely impassable until removed. Although similar, the work was much more elaborate than was customary in our civil war.

MUSEUM OF MODELS.

Here I saw a large table about 25 feet by 15 feet contoured to a scale and with with woods, villages, &c., all in relief, for playing kriegspiel. The pieces were moved by a "magnet rod," of which I did not see the working.

There were many large models of fortifications, including a study of an attack upon a city defended with detached forts on the modern plan. Three forts were included in the attack, and the subsequent sapping to the central keep or city was indicated.

There were many arms and military curiosities exhibited; and surrounding the room were tablets containing the name, rank, and date of death of all officers of the Royal Engineers killed in battle since about the beginning of the present century—in number ninety.

PHOTOGRAPHY AND LITHOGRAPHY.

This work, as done at Chatham, is so excellent and so well known that I will only mention a novelty. An impression was shown me obtained by treating a newspaper picture with acid and transferring the printers' ink to the stone. The effect was fine, resembling an old etching, and they had printed about fifty copies. It was a view of an old cathedral, of which several copies were needed for some architectural purpose.

It was gratifying to see that the photographs received from Willets Point are exhibited among their collection in a conspicuous place.

ASTRONOMICAL OBSERVATORY.

They have a new one recently erected. It contains a good field transit with a filar micrometer, a four-inch equatorial, an astronomical clock, a portable transit, and several sextants. They own a zenith telescope, but it is not mounted. In fact only a limited use is made of the observatory. Only such officers as are about to be sent on astronomical duty receive full instruction. In this department less practice is required than we give at Willets Point, a remark which is also true in respect to surveys, hydrographic work, and reconnaissances which are hardly taught practically at Chatham.

FIELD TELEGRAPHY.

The latest novelty is a "buzz sounder." It has a secondary coil of small size in the main line. The primary worked by the local battery contains an automatic interrupter. The receiver is a bell telephone, which gives out a sound sharper and more distinct than an ordinary Morse sounder. This arrangement is regarded as a decided success, and it is understood to be adopted for service.

BALLOONS IN WAR.

Perhaps the most interesting investigation for field operations is the course of experiments with war balloons now in progress. Two objects are in view—reconnaissance by personal view and reconnaissance by use of instantaneous photog-

raphy. For the former a large balloon is required, such as we used in the late war; but for the latter only a small one about 6 feet in diameter is needed. It raises a little camera, and the picture is taken with the aid of electricity. As yet they have arrived at no practical success, but I understand that one fair view has been thus secured in Canada.

They find goldbeaters' skin far better than silk for the material. It is obtained from slaughter-houses at little cost, being the inner skin of the lower intestine of an ox. It comes in small bits about 2 inches by 4 inches, each animal yielding about 1.5 square feet. To make the balloon cover, three thicknesses of this material are formed by pressing one upon the other, breaking joints. The natural moisture causes adherence. The outside is varnished, then a fourth layer is added and covered with a coat of oil. This material will hold hydrogen gas remarkably, permitting an ascent eleven days after filling.

Much attention has been paid to the details needful in field service. The sulphuric acid for generating the hydrogen is carried in a large lead tank to avoid the danger of breaking carboys. The balloon is held down by a fine cord not larger than one's finger, which is carried on a reel at the rear end of one of the wagons. A safety-brake is used; but this is hardly perfected, since both horse and wagon were lifted suddenly into the air to an estimated height of 100 feet by a violent gust of wind quite recently. No harm resulted. The rope, now of cotton but probably to be made of silk, is to allow the observer to rise 4,000 feet (much higher than we attempted in the late war). As yet everything is tentative.

ELECTRICAL CRANE AT BOURGES.

In one of the shops at the army gun factory at Bourges, France, we saw a very interesting application of electricity which may perhaps find a place upon some of our special works of construction in the future.

This shop is about 300 feet from another building which contains an immense engine driving many different machines, and therefore necessarily possessing considerable surplus power. It was considered that through the agency of electricity some of this might be made available in the first-named building, for performing the intermittent kind of work required of a large crane. The engine was accordingly connected permanently with the armatnre of a large Gramme machine, the work of revolving this armature being practically nil except when the external circuit is closed.

This external circuit was carried to the building in question by two large copper conducting wires, which were conveniently led overhead in such a manner as to supply a rubbing contact at all desired parts of the shop.

The crane was of the usual overhead pattern, travelling longitudinally on rails running over the bays containing the tools to be served. Convenient cross tracks were arranged for shunting its carriage from one bay to another, so that one single crane could perform work in any part of the building. Its lifting power was about 20 tons. Contact brushes on the carriage rubbed the wires, and thus extended the circuit down to a second Gramme machine suspended from the carriage at a convenient level near the floor. When a permanent break in the circuit near this machine was closed by the operator, the current traversed the second Gramme which thus became a motor, its armature revolving by the power of the distant engine transmitted through the agency of the current.

I estimated the size of this motor armature at 12 inches in diameter by 18 inches long. Each end of its axis was extended beyond the field magnets to carry a leather-wrapped pully, about 18 inches in diameter. They rubbed iron pulleys

about 30 inches in diameter, which were connected to trains of gearing so arranged as to move the carriage on the tracks, or to shift the crane laterally on the carriage, or to raise and lower the suspended weight, as desired.

The following electrical data were furnished by the officer in charge. The armature of the generating machine revolves about 1,000 times per minute; and that of the motor from 600 to 1,000 times. The electromotive force is about 400 volts and the current about 35 ampéres. The system can transmit the power of about 12 horses with an economic return of $\frac{60}{100}$. The cost of the crane was about $7,000. It was made by Bon et Lustremont, 25 Rue Poissonnière, Boulevard Poissonnière, Paris. It was favorably regarded, its working being economical and convenient under the special circumstances of the case.

DANISH SUBMARINE MINES.

A very novel system of mines was recently exhibited at Vienna by the Danish Submarine Mining Service, respecting which I learned the following particulars from Royal Engineer officers who had examined it.

The basis of the system is a remarkable low tension fuze, far exceeding in sensitiveness any heretofore made. The bridge is 11 millimetres long, and composed of an alloy of platinum and silver. For a space of about 2 millimetres the silver is eaten away with nitric acid, leaving the platinum of excessive fineness. This is the only peculiarity of the fuze. The following table exhibits the characteristics of two different varieties:

Danish Sensative Fuzes.

Nomenclature.	Diameter in Millimetres.	Resistance in Ohms.	Firing Current in Ampéres.
F. 0.8	0.00675	9 to 14	0.05 to 0.04
F. 0.12	0.005		0.046 to 0.038

It is apparent that with a firing current ranging between 0.03 and 0.05 of an ampére no safe tests could be made of the mines through a circuit including the earth. This is recognized by the Danes, and they claim that such tests are unnecessary. The system is the following:

The fuze, or rather two of them in derived circuit, are placed between the circuit closer and the iron torpedo case. A cable, not exceeding 5 Siemens units in resistance, extends from the other terminal of the circuit closer out of the torpedo and beyond dangerous range—say any distance up to one-third of a mile. So long as the free end of this cable remains in the air the mine is safe to handle and plant.

About 20 such mines are placed as desired, and the free ends of their cables are brought to a common position.

A special earth-plate is now made ready. It consists of a large box (I think of iron) about 30 inches long and 18 inches wide, packed full of coal. "Cinders" are recommended, but probably charcoal or bituminous coal is intended. When the cores of the cables are united to this earth-plate, and it is submerged in the sea, the mines all become active; for, when any circuit closer is struck, a sea-cell current will flow through the cable having an electro-motive force of about 1 volt, and possessing at least the needful strength to explode the fuze, viz:

$$C = \frac{1.0}{14 + 5} = 0.05 \text{ ampéres.}$$

It is evident that such a system could be rapidly and safely planted, but it would be dangerous alike to friends and foes. This difficulty is easily met at any time subsequently (or at the planting) by uniting the 20 cores to a single conductor, leading it through a simple relay, at which the circuit normally remains broken, and thence to the carbon earth-plate. Another cable extended from the shore, and led through the electro-magnet of the relay to earth would render it easy for the operator to make his mines sensative whenever he desired by simply applying an ordinary battery in the direction needful to close the relay contact points.

No cut-offs would be required with such a system, for as soon as a mine is exploded its cable is deprived of one earth-plate, and the flow will cease.

For rapidly closing a harbor, especially if torpedo cable were deficient or bad in quality, this plan seems to me well worthy of study. Its defects are the impossibility of testing the condition of the mines, and the fact that judgment firing is sacrificed. The uniformity and safety of the fuze would seem to be the essential points for investigation. The Danish officers claim that the electro-motive force of the sea-cell rises to fully 1 volt after about two days submergence of the carbon plate, and that it can be at once brought to this value by pouring a little nitric acid over the coal. Some old investigations at Willets Point tend to confirm this statement.

TORPEDO CABLE.

I learned at Henley's works, London, how they prepare their ozokerite cable. The dialectric consists of a wrapper of pure rubber, then a separator, and then a wrapping of rubber containing a small percentage of sulphur. The core thus formed is vulcanized, and a wrapping of felt is applied. The completed core is then boiled for two or three hours in ozokerite, which increases the weight about 40 per cent.

Siemens Brothers of London, have made recent improvements in the manufacture of gutta-percha cables. They no longer use Chatterton's compound to unite the successive layers; and they subject the completed core to hydraulic pressure, with a view to consolidate it.

The pressure is applied in a strong steel cylinder 30 inches in diameter, and about 2 feet high. The core is inserted and the top is closed with a slotted screw fermature resembling the French Ordnance pattern. The pressure is supplied by an accumulator, a heavy mass of iron raised by pumping water under two large rams, and then allowing the weight to rest on a small ram supported by a column of water communicating with that enclosed in the cylinder around the gutta-percha core. The pressure is thus raised to about 4 tons per square inch, and it is continued fifteen minutes or more. The advantage of this treatment is said to be very marked.

TORPEDO BOATS IN EUROPE.

Mr. Nordenfeldt, and perhaps others, have been interested in a recent trial on the Thames of a new boat made by Mr. Lay for the Turkish Government. This trial was promised in August, but was delayed until October. Hobert Pasha waited several weeks to see it, but finally left before it occurred.

The present cable of this torpedo has three cores each insulated separately with ozokerite and lightly taped, and the whole bound together with an outer wrapping of tape. It weighs 170 pounds per mile. One core is used to steer, one to fire, and the other to raise and lower rods, start and stop, &c. Mr. Lay uses higher

gas pressure than formerly, and is reported to claim a speed of half a mile in two minutes eighteen seconds; but no measurements appear to have established accurately the rate of motion.

It is rumored that Mr. Nordenfeldt has devised a submarine boat 60 feet long driven by steam under water, which has actually made 14 miles in two hours. The depression is said to be effected by vertical screws, thus avoiding the dangers of excessive ballast.

I saw at Portsmouth, on the Polyphemus, an arrangement which in my judgment will render any boat on the Lay system running on the surface of the water quite inadmissible.

The Polyphemus is provided with six Nordenfeldt guns, each firing inch bolts, and served by two men in a steel revolving shield which is bullet proof. One man fires the gun by the lever as rapidly as possible, say at the rate of from 100 to 200 shots per minute. A second man manipulates two hand wheels; with one he controls the elevation of the gun with great facility, and with the other he revolves the whole apparatus, thus directing the fire in azimuth. With the splashes of the shot in the water to guide him, and with ordinary coolness and skill, he could hardly fail to strike an approaching torpedo boat moving on the surface—and one shot would be fatal.

NEW ORGANIZATION OF ENGINEER TROOPS IN RUSSIA.

By a recent order of the minister of war, issued on the 12th of May, 1883, the organization of the engineer troops is changed to the following:

IN TIME OF PEACE.

Five Sapper brigades in European Russia; one Sapper brigade in Caucasia; and two engineer siege parks—at Dynaburgh and Kieff.

A Sapper brigade consists of three Sapper battalions, two Pontonier battalions (except fifth brigade, which has only one Pontonier battalion), three military telegraph parks, one field engineer park.

To the first, second, third, and fourth brigades is attached one military railway sapper battalion. It is very probable that the railway battalions will have an independent organization.

Each of 15 Military Telegraph battalions has all material needful for constructing telegraph lines. The total length of telegraph wire for all of them is about 650 miles.

With each Field Engineer Park is one company especially charged with explosives for mines, &c., and one company of Electricians.

IN TIME OF WAR.

To each brigade is added in European Russia thirty Reserve Sapper companies and four Reserve Sapper battalions; and in Caucasia four Reserve Sapper companies.

As with us, the service of defensive submarine mines is assigned to the Engineer troops. I much regretted that time did not permit a visit to their establishment at St. Petersburg. The Naval Torpedo School at Cronstadt has received much attention from the government, and is in a flourishing condition. The fabrication of Whtehead torpedoes is there carried on upon an extensive scale.